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RHIZOPOGON IN NORTH AMERICA

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RHIZOPOGON

Rhizopogon Fries & Nordholm emend. Tulasne, Giorn. Bot. Ital. **2**: 56–63. 1844; Fries & Nordholm, Symb. Gast. **1**: 5. 1817; Fries, Syst. Myc. **2**: 293–294. 1823; Summa Veg. Scand. 435. 1849; Tulasne, Fung. Hypog. 85–91. 1851; DeToni in Sacc. Syll. Fung. **7**: 161–164. 1888; Hesse, Hypog. Deutschl. **1**: 86–94. 1891.—Not Corda, Anleit. z. Stud. Myc. (lxxxiii) 110. *pl. D. 46. f. 16–18.* 1842.—*Hysteromyces* Vittadini, Notiz. nat. e civ. sulla Lombardia **1**: 340. 1844.—*Splanchnomyces* Corda in Sturm, Deutschl. Fl. **3**: 3–4. *pl. 2.* 1831; Anleit. z. Stud. Myc. (lxxxii) 107. *pl. D. 45.* 1842; Icon. Fung. **5**: 26. 1842; *Ibid.* **6**: 37–45. 1854, (in part); Nees v. Esenbeck, Th. F. L. & Henry, A. Syst. d. Pilze **1**: 73. *pl. 10.* 1837.

The type species of the genus is *Rhizopogon luteolus* Fries & Nordholm emend. Tulasne.

Fructifications globose, ellipsoidal and oblately spheroidal to irregular; fibrils filiform, terete or flattened, loosely or innately appressed, simple or anastomosing, leading to rhizomorphs, usually dark-colored when dry; peridium either thick, subcoriaceous, stupose, or thin, submembranaceous, and separable from the gleba with difficulty if at all, context either compact or loosely woven; gleba at first white, becoming

darker; cavities irregular, subequal, at first hollow, then more or less filled with spores; septa homogeneous or scissile, composed of branched interwoven hyphae, often gelatinizing at maturity; basidia varying from ovoid to cylindrical, 2–8-spored; spores ellipsoidal, unicellular, 1–2-guttulate, sometimes appearing 2-celled at maturity, due to the peculiar position the nucleus assumes.

In 1817 Fries and Nordholm described *Rhizopogon luteolus,* and Fries (1823) added three species, one of which proved to be an ascomycete, and the other two, synonyms of *R. luteolus.* Vittadini, Corda, and others treated the genus as ascomycetous, considering *Rhizopogon albus* Fries (1823) as the type. Corda (1831) described *Splanchnomyces,* with *S. roseolus* (see p. 16) as the type, and later added many other species which are to be looked for in various modern genera of the *Hymenogastraceae.* Vittadini, after having *Hysteromyces* in manuscript for several years, published it, with *H. vulgaris* (*Rhizopogon rubescens* var. *Vittadinii* Tulasne) as the type, in the same year (1844) in which Tulasne emended the genus *Rhizopogon* Fries & Nordholm.

Not until a later paper will we attempt a discussion of the relations of *Rhizopogon* to the other genera of the *Hymenogastraceae,* but the taxonomic study of the genus has unearthed a series of forms which anticipate a very interesting morphological development within the genus, should sufficient histological study be possible. We refer here particularly to the simplex and duplex character of the peridium. The outer layer of the duplex forms is sometimes very thin (*R. maculatus*) or often is thick and cracked (*R. pannosus* and *R. Briardi*). Is the thin outer layer of some of the species of *Rhizopogon* comparable to the universal veil or "blematogen" found in the button stage of some of the evolvate agarics and reported by Conard[1] in *Secotium agaricoides?* Or, is the thick, cracked, outer layer of such forms as *R. pannosus* and *R. Briardi* comparable to the volva of certain *Agaricaceae* and *Phallaceae?* These questions can be answered only after

[1] Conard, H. S. The structure and development of Secotium agaricoides. Mycologia **7**: 94–104. *pl. 157.* 1915.

satisfactory study of the development of the fruit-bodies has been made by those to whom fresh material in all stages is accessible.

Although we have had the opportunity to study a few specimens which were put up in alcohol, our descriptions are based on dry herbarium specimens, as is also our key. As a standard for color descriptions we have used Ridgway, 'Color Standards and Nomenclature,' Washington, D. C., 1912. As to the citation of specimens, the data given are those received with the specimens. The location of all specimens is designated by giving in parenthesis the name of the herbarium preceded by "in."

We gratefully acknowledge all who have aided us in the study of herbarium material, making possible this record of species of *Rhizopogon*. We are thus indebted to the Missouri Botanical Garden for the use of library and herbarium facilities; to Dr. E. A. Burt for helpful suggestions and access to his private herbarium; to Dr. LeRoy Abrams for the opportunity to study specimens from the Dudley Herbarium of the Leland Stanford Jr. University; to Prof. G. F. Atkinson for specimens from his herbarium; to Dr. H. M. Fitzpatrick for specimens from the Department of Plant Pathology Herbarium, New York State College of Agriculture at Cornell University; to Dr. N. L. Gardner for access to his own collections of *Rhizopogon;* to Dr. H. D. House for permitting us to study the collections in the New York State Herbarium; to Mr. C. G. Lloyd for access to the extensive collection of *Rhizopogon* in his herbarium; to Dr. W. R. Maxon for sending us specimens from the United States National Herbarium; to Dr. W. A. Murrill for the opportunity to study the unmounted specimens of *Rhizopogon* in the New York Botanical Garden Herbarium; to Mrs. F. W. Patterson for the privilege of studying the specimens in the Pathological Collections, Bureau of Plant Industry, United States Department of Agriculture; and to Dr. J. R. Weir for specimens from Idaho.

Key to North American Species

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    6. Peridium thin (60–240 μ), light-colored ..... *R. occidentalis* (p. 14)
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11. Peridium thicker (260–400 μ), spores 6–8×3 μ ..... *R. rubescens* var. *Vittadinii* (p. 20)

1. **Rhizopogon maculatus** Zeller & Dodge, sp. nov.

Fructificationes subglobosae vel olivaeformes, 1–2 cm. diametro metiens, post siccandum maxime contractae, "pale grayish vinaceous" vel "vinaceous-brown" (Ridgway), siccatae saturatiores, sordide albidis cum maculis, ubi peridi stratum exterum manet; funiculi pauci, prominentes, inferne radiciformes, innati-applicati in parietibus, superne evanescentes, "vinaceous-brown" (Ridgway), vel saturatiores; peridium tenue, 20–60 μ crassitudine, duplex, stratum exterum hyphis hyalinis implexum, qui facile a strato intero divelli potest; stratum interum saturatius, "ochre-red" (Ridgway), compactum, dimidia exteri crassitudine; gleba recens albida, grisea et ossea siccata; locelli angusti, irregulares, vacui; septa 40 μ crassitudine, hyalina, hyphis gelatinosis compacta, non scissilia; basidia inconspicua, hyalina, tetraspora, sterigmatibus circa 3 μ longitudine; sporae acrogenae, subfusiformes, hyalinae, leves, 2-guttulatae, 7–10×3–4 μ.

Habitat in terra arenosa in pinetis. California. Veri.

Type: in Zeller Herb. and Dodge Herb.

Fructifications subglobose to olive-shaped, 1–2 cm. in diameter, shrinking to almost nothing on drying, color pale grayish vinaceous to vinaceous-brown, drying to dark vinaceous-brown, mottled with dirty white patches due to the partial sloughing off of the outer peridial layer; fibrils few and conspicuous, rhizomorph-like below to innate-appressed over the sides, disappearing above, vinaceous-brown or darker; peridium thin, 20–60 μ thick, duplex, the outer layer of loosely interwoven, hyaline hyphae, easily separable from the inner layer, which is darker, ochre-red, compact, about one-half the thickness of the outer layer; gleba white when fresh to grayish and bony hard when dry; cavities narrow and irregular, empty; septa average about 40 μ thick, hyaline, made up of much gelatinized hyphae, not scissile; basidia inconspicuous, mostly 4-spored; sterigmata about 3 μ long; spores acrogenous, hyaline, subfusiform, 7–10$\times$3–4 μ, 2-guttulate, smooth.

In sand under conifers. California. Spring.

R. maculatus is like *R. Briardi* and *R. pannosus* in that the peridium is duplex and the outer layer is partially sloughed off in patches, and it is also closely allied to *R. diplophloeus* and *R. angustisepta* in that it has a duplex peridium.

Specimens examined:

California: San Francisco, *N. L. Gardner,* type (in Zeller Herb., 1382, and Dodge Herb., 834).

2. Rhizopogon viridis Zeller & Dodge, sp. nov.[1]

Fructificationes oblatae-sphaeroideae, 1$\times$2 cm. metiens, post siccandum non contractae, "citrine-drab" vel "olivaceous black(1)" (Ridgway), siccatae saturatiores, superficie maculata, superne squarrosa; funiculi pauci, innati-applicati, non prominentes, nigri; peridium crassum, 300–500 μ crassitudine, duplex, stratum exterum 100–200 μ crassitudine, "Vandyke brown" (Ridgway) sub lente, hyphis magnis septatis laxe complexum; stratum interum stuposum, 200–300 μ crassitudine, "Sayal brown" (Ridgway); gleba servata "olive" vel "deep olive" (Ridgway), siccata saturatior; locelli subglobosi vel irregulares, vacui; septa 30–35 μ crassitudine inter hyme-

[1] The specimens of *Rhizopogon viridis* came to us after the paper was in press and thus too late to insert drawings.

nia, hyalina, hyphis magnis, gelatinosis, laxe contexta, non scissilia; basidia conspicua, oblonga, hyalina, parietibus gelatinosis, 9–16×6.5–8 μ, mono- vel tetraspora, sterigmatibus brevibus; sporae acrogenae, olivaceae acervatae, singulatim hyalinae, ellipsoideae, leves, saepe diguttulatae, 5–8×2–3 μ.

Habitat sub foliis in pinetis. Idaho. Autumno.

Type: in Weir Herb., Zeller Herb., and Dodge Herb.

Fructifications oblate-spheroidal, 1×2 cm., not shrinking on drying, citrine-drab to olivaceous black(1) when fresh, drying darker, surface somewhat mottled due to the partial sloughing off of the darker outer layer, the darker places squarrose; fibrils scanty, innate-appressed, inconspicuous, black; peridium thick, 300–500 μ, duplex, the outer layer 100–200 μ, Vandyke brown under the microscope, composed of large, loosely woven, septate hyphae, the inner layer stupose, 200–300 μ thick, Sayal brown under the microscope; gleba olive to deep olive in preserved material, drying to dark olive; cavities subglobose to irregular, empty; septa 30–35 μ, hyaline, composed of large, loosely woven, gelatinized hyphae, not scissile; basidia conspicuous, oblong, hyaline, with gelatinized walls, 9–16×6.5–8 μ, 1–4-spored; sterigmata short; spores acrogenous, olive in mass, appearing hyaline when alone, ellipsoidal, 5–8×2–3 μ, often 2-guttulate.

In pine leaf mould. Idaho. September to October.

Rhizopogon viridis presents a mottled appearance of the fructifications, as does *R. maculatus,* but the colors of the two species are distinct and the lighter spots on *R. viridis* are due to the inner peridial layer, while in *R. maculatus* they are due to the outer layer. The hyphae of the outer peridial layer have a suggestion of the condition to be found in *R. diplophloeus.*

Specimens examined:

Idaho: Priest River, *J. R. Weir,* type (in Weir Herb., Zeller Herb., 1447, and Dodge Herb., 849).

3. **Rhizopogon pannosus** Zeller & Dodge, sp. nov.

Fructificationes caespitosae, subpiriformae vel subglobosae, et irregulares, 1.5–3 cm. diametro metiens, "russet-vinaceous" vel "sorghum-brown" et "light seal-brown" (Ridgway) ubi tactae, pannis "sorghum-brown" (Ridgway) relictis cum hoc stratum ruptum est;

funiculi inconspicui, superne fere desunt, aut innati-applicati sunt, inferne breves sed magni, leves, fere politi, "light seal-brown" (Ridgway); peridium crassum, 440–1000 μ, duplex, strato extero facile ab intero separante, pannis relictis, 200–500 μ crassitudine, hyphis laxe implexis, "vinaceous-russet" (Ridgway) sub lente, strato intero 240–600 μ crassitudine, compactiore dilutioreque extero, hyphis granulosis contexto, "Corinthian red" (Ridgway) extus, vel cremeo intus; gleba "light buff" (Ridgway) siccata, coriacea; locelli subglobosi vel irregulares, vacui; septa 100 μ crassitudine, hyalina, hyphis septatis laxe implexis, subscissilia; basidia hyalina, 7–8×16 μ, mono- vel pluri-sporifera, oblonga, sterigmatibus 3–5 μ longitudine; sporae acrogenae, hyalinae vel cremeae acervatae, ellipsoideae, 7–9×3–5 μ, 1–2-guttulatae, leves.

Habitat in viis. America occidentale. Aestate.

Type: in Zeller Herb. and in Dodge Herb.

Fructifications cespitose, subpyriform to depressed globose and irregular, 1.5–3 cm. in diameter, from russet-vinaceous to sorghum-brown and light seal-brown where bruised, the sorghum-brown patches of the outer peridial layer being isolated as this layer cracks; fibrils inconspicuous, almost entirely wanting above to innate-appressed below, where they are short but large, appearing as large, smooth, almost shiny ridges, light seal-brown; peridium thick, 440–1000 μ, duplex, thick sections more or less claret-brown under the microscope, the outer layer easily separable from the inner, sloughing off, leaving patches 200–500 μ thick, of loosely woven hyphae, vinaceous-russet under the microscope, inner layer 240–600 μ thick, more compact and lighter than the outer layer, made up of granular hyphae, from Corinthian red in the outer part to creamy within; gleba light buff when dry, coriaceous; cavities averaging 5–6 per mm., subglobose to irregular, empty; septa average about 100 μ broad, hyaline, composed of loosely woven, septate hyphae, more or less scissile; basidia hyaline, 7–8×16 μ, 1–several-spored, oblong; sterigmata one-half as long as spores; spores acrogenous, hyaline to cream-colored in mass, ellipsoid, 7–9×3–5 μ, 1–2-guttulate, smooth.

In trampled roadways. Pacific Coast. Early summer.

R. pannosus, although quite closely related to *R. Briardi,* is a distinct species. The isolated patches of the outer peridial layer are much more conspicuous than in *R. Briardi*

and the colors of the two are distinct. The septa of *R. Briardi* are composed of a pseudo-parenchymatous tissue, while in *R. pannosus* the hyphae are loosely woven and the septa are somewhat scissile and about twice as broad as in *R. Briardi.*

Specimens examined:

Washington: Klickitat Co., Falcon Valley, *W. N. Suksdorf, 629, 1029* (in Lloyd Mus., 5603 and 11443, respectively).

California: Mariposa Co., *W. A. Setchell,* type (in Zeller Herb., 1380, and in Dodge Herb., 835).

4. **Rhizopogon diplophloeus** Zeller & Dodge, sp. nov.

Fructificationes globosae vel irregulares, diametro 1–2.5 cm. metiens, argillaceae recens lectae, tactu brunnescentes, demum "Verona brown" (Ridgway) et nigrescentes siccatae; funiculi pauci radicantes, innati-applicati, nigri; peridium crassum, duplex, stratum exterum 140–180 μ crassitudine, hyphis bulbosis, sub lente fulvis, laxe complexum; stratum interum 260–300 μ crassitudine, hyphis melleis dense compactum; gleba "Isabella-color" (Ridgway) fulvescens, siccata ossea, nigrescens; locelli globosi, irregulariusculi, recens vacui, maturitate sporis repleti; septa 30–40 μ crassitudine, hyphis subhyalinis compacta, non scissilia; basidia clavata, 25–30 $\times$12–18 μ, hyalina, di- vel octospora, vulgo octospora, sterigmatibus 6–10 μ longitudine; sporae acrogenae, ellipsoideae, dilute cremeae sub lente, leves, 5.3–7$\times$2–3.5 μ, diguttulatae.

Habitat inter rhizoma *Adianti pedati* in lateribus rupium. Washington. Aestate.

Type: in Zeller Herb., Dodge Herb., and Mo. Bot. Gard. Herb.

Fructifications globose to irregular, 1–2.5 cm. in diameter, "clay colored" when fresh, becoming darker when bruised, Verona brown to nearly black when dry; fibrils scanty, innate-appressed, black when dry, leading to rhizomorphs; peridium 400–480 μ thick, duplex, the outer layer dark tawny under the microscope, about 140–180 μ thick, composed of irregularly swollen hyphae, loosely interwoven, the inner layer honey-colored, about 260–300 μ thick, composed of closely woven hyphae; gleba from Isabella-color to brown or almost black on drying, bony hard when dry; cavities subglobose to somewhat irregular, empty when young, filled with spores at maturity; septa 30–40 μ thick, composed of compact, subhyaline hyphae, not scissile; basidia clavate, 25–30$\times$12–18 μ,

hyaline, 2–8-spored (mostly 8-spored); sterigmata 6–10 μ long; spores acrogenous, dilute cream-colored under the microscope, ellipsoid, 5.3–7×2–3.5 μ, smooth, often 2-guttulate.

Clinging to sides of an overhanging rocky cliff among rhizomes of *Adiantum pedatum*. Washington. Summer.

Specimens examined:

Washington: Friday Harbor, *S. M. Zeller, 1360,* type (in Zeller Herb., 1360, Dodge Herb., 823, and Mo. Bot. Gard. Herb., 54977); Bingen, *W. N. Suksdorf, 811* (in Lloyd Mus., 7300).

5. **Rhizopogon pachyphloeus** Zeller & Dodge, sp. nov.

Fructificationes ovoideae, 2.5–3 cm. in diametro metiens, post siccandum compactae, recens ochraceae vel isabellinae (Murrilli memoranda), "Brussels-brown" vel "bay" (Ridgway) vel saturatius; odor foetidus, non late penetrans (Murrillo teste); funiculi prominentes, tenues, innati-applicati, ramosissimi, etiam reticulati, totam fructificationem in reticulo circumcludentes, fusci, peridio saturatiores, purpurescentes semitranslucentesque; peridium 540–600 μ crassitudine, simplex, compactum, hyphis irregularibus vesiculosis contextum, gelatinosis, "yellow-ochre" (Ridgway) sub lente; gleba umbrina, albidis cum maculis recens conspersa, siccando nigrescens, recens mollis et gelatinosa, sed sicca dura, nitensque ubi caesa; locelli subglobosi vel irregulares, sporis impleta, circa 120 μ latitudine; septa 40 μ crassitudine, hyalina, hyphis gelatinosis contexta, non scissilia; basidia prominentia, hyalina, gelatinosa, 6–8×11–13 μ, piriformia, sterigmatibus brevibus; sporae umbrinae, acrogenae, cremeae sub lente, ellipsoideae, rare allantoideae, 1–2-guttulatae, leves, nucleo longo media in cellula locato, 3–5×5–10 μ.

Habitat in terra inter lichenes. Ubique. Hieme.

Type: in N. Y. Bot. Gard. Herb.

Fructifications ovoid, 2.5–3 cm. in diameter, perceptibly shrinking on drying, "ochraceous to isabelline" (Murrill) when fresh, drying to Brussels-brown or even bay and darker; odor "foul but not very 'spreading' " (Murrill); fibrils prominent, slender, innate-appressed, much branched and reticulated, enclosing the whole fructification in a net, brownish when drying, darker than the peridium, color "red-amber," semi-translucent; peridium thick, 540–600 μ, simplex, compact, of interwoven, irregularly vesiculose, gelatinized, large hyphae, yellow-ochre under the microscope; gleba

umbrinous, mottled with white when fresh, drying almost black, cut surface shiny, hard when dry, but soft-gelatinous when fresh; cavities subglobose to irregular, filled with spores, about 120 μ broad; septa about 40 μ broad, hyaline, of very gelatinized hyphae, not scissile; basidia quite prominent, hyaline, gelatinized, 6–8$\times$11–13 μ, pyriform; sterigmata short; spores raw umber in mass, acrogenous, creamy, ellipsoid, sometimes somewhat allantoid, 1–2-guttulate, smooth, nucleus long, equatorially placed, 3–5$\times$5–10 μ.

On bank among lichens. Cosmopolitan. December to January.

This species seems to be closely related to the forms having duplex peridia through *R. diplophloeus,* in that both have vesicular cells in the hyphae of the outer portion of the peridium. In external appearance it resembles *R. luteolus,* while the greatly gelatinized basidia relate it to *R. roseolus.*

Specimens examined:

Exsiccati: Rabenhorst-Winter, Fung. Eur., 3436, under the name *Melanogaster Owanianus* Kalchbr. in herb.

Africa: Cape Good Hope, near East Somerset, *P. MacOwan,* in Rabenhorst-Winter, Fung. Eur., 3436 (in Mo. Bot. Gard. Herb., 5646).

Jamaica: Cinchona, *W. A. & E. L. Murrill, 605,* type (in N. Y. Bot. Gard. Herb.).

Colorado: Fort Collins, *B. O. Longyear* (in Lloyd Mus., 12556).

Australia: Sydney, *R. T. Baker* (in Lloyd Mus., 03957).

6. **Rhizopogon luteolus** Fries & Nordholm emend. Tulasne, Giorn. Bot. Ital. **2**: 57. 1844; Fries & Nordholm, Symb. Gast. **1**: 5. 1817; Fries, Syst. Myc. **2**: 294. 1823; Summa Veg. Scand. 435. 1849; Wahlenberg, Fl. Suec. **2**: 997. 1826; Rabenhorst, Fl. Lusatica, Abt. II. 388. 1840; Deutschl. Krypt. Fl. **1**: 246. 1844; Desmazières, Pl. Crypt. Exsicc., ed. 2, 21. No. 1013. 1846; Tulasne, Fung. Hypog. 87–88. 1851; DeToni in Sacc. Syll. Fung. **7**: 161. 1888; Hesse, Hypog. Deutschl. **1**: 87–89. 1891.—Not Krombholz, Nat. Abbild. u. Beschr. Schwämme **8**: 21. *pl. 60, f. 13–15.* 1843; nor Karsten, Finska

Vet.-Soc. Bidrag Natur och Folk **25** : 354. 1876. (Myc. Fenn. **3** : 354. 1876).

Splanchnomyces luteolus Corda, Icones Fung. **6** : 38. *pl. 7. f. 69.* 1854.—*Splanchnomyces Rabenhorstii* Corda, *Ibid.* **6** : 39–40. *pl. 8. f. 73.* 1854.—*Splanchnomyces Cauvinianus* Corda, *Ibid.* **6** : 39. *pl. 8. f. 72.* 1854.—*Hysterangium Duriaeanum* Tulasne, Actes Soc. Linn. de Bordeaux **13** : 263. 1844.

Illustrations: Hesse, Hypog. Deutschl. **1** : *pl. 2. f. 1–4, pl. 5. f. 5–7, pl. 9. f. 26;* Tulasne, Fung. Hypog. *pl. 1. f. 5, pl. 11. f. 5.*

Type: location unknown, but a specimen from Lloyd which we have studied is from the type locality.

Fructifications subglobose to oblong and often pear-shaped, diameter up to 3 cm. when dry, color warm buff to mummy-brown when dry; odor weak at first and later stercoreous (Tulasne); fibrils numerous but not prominent, fine, elastic, about the same color as the peridium or darker, composed of septate hyphae, innate-appressed above and not very prominent below; peridium thick, 240–400 μ, simplex, context meshy and quite loose, stupose, ochraceous-buff to ochraceous-tawny under the microscope; gleba white at first, then yellowish when dry; cavities narrowly labyrinthiform, empty or filled with spores where the cavities are small; septa narrow, 30–60 μ, made up of hyaline, branched hyphae mostly extending parallel with the surface of the hymenium, becoming scissile early; basidia clavate, 12–13$\times$9–10 μ, hyaline; sterigmata as long as the spores; spores acrogenous, distinctly colored, ochraceous-tawny, ellipsoidal, 7–16$\times$3–5 μ, smooth.

In sandy coniferous woods. Cosmopolitan.

Jamaica material collected by F. S. Earle, 358, does not agree in all characters with the other *R. luteolus* material. This form has a thinner peridium and less numerous fibrils than in other specimens. No field notes accompany this collection. The colors when fresh are characters which are very desirable in the separation of species like *R. rubescens* and *R. luteolus.*

Specimens examined:

Exsiccati: von Höhnel, Krypt. Exsicc., 1607; Klotzsch, Herb. Myc., ed. 2, by Rabenhorst, **4**: 320. 1856; Rabenhorst, Crypt.-Samml. f. Schule u. Haus **1**: *pl. 13;* Ravenel, Fung. Car. **1**: 75, under the name *Rhizopogon rubescens;* Schroeter, Pilze Schles., 1685; Sydow, Mycoth. Germ., 1060; *Ibid.*, 1061, 1062, under the name *Rhizopogon provincialis;* Westendorp & Wallays, Herb. Crypt. Belg. **1**: 39.

Norway: Ekerö, *L. Romell* (in Burt Herb.).

Sweden: Upsala, *C. G. Lloyd, 1908* (in Lloyd Mus., 08559).

Germany: *L. Rabenhorst,* Crypt.-Samml. f. Schule u. Haus **1**: *pl. 13* (in Mo. Bot. Gard. Herb.); *Klotzsch,* Herb. Myc., ed. 2, by Rabenhorst, **4**: 320 (in Mo. Bot. Gard. Herb.); *P. Hennings,* under the name *Rhizopogon virens* (in Ellis Coll., N. Y. Bot. Gard. Herb.); East Prussia, Tilsit, *W. Krüger, 2* (in Lloyd Mus., 6693); Silesia, Falkenberg, *J. Schroeter,* Pilze Schles., 1685 (in Lloyd Mus., 1685); Pomerania, Gutsdorf bei Callies, *P. Sydow,* Mycoth. Germ., 1062 (in Mo. Bot. Gard. Herb.); Brandenburg, Sophienstadt bei Biesenthal, *P. Sydow,* Mycoth. Germ., 1060 (in Mo. Bot. Gard. Herb.), Berlin, *P. Magnus* (in Cornell Univ. Herb.), Berlin 'bei Westend,' *P. Magnus* (in Mo. Bot. Gard. Herb., 55099), Triglitz i. d. Prignitz, *O. Jaap, 13* (in Lloyd Mus., 03905); Westphalia, *P. Magnus* (in Lloyd Mus.).

Austria: Tyrol, Jenesien bei Bozen, *F. von Höhnel,* Krypt. Exsicc., 1607 (in U. S. Nat. Herb.).

Belgium: Flanders, *G. D. Westendorp & A. C. F. Wallays,* Herb. Crypt. Belg. **1**: 39 (in Mo. Bot. Gard. Herb.).

France: Barbison, *C. G. Lloyd* (in Lloyd Mus., 06373).

South Africa: Stellenbosch, *A. V. Duthie* (in Lloyd Mus., 77).

Massachusetts: South Yarmouth, *S. Davis* (in Lloyd Mus., 5895).

New York: West Port, *C. H. Peck* (in Coll. N. Y. State); Ithaca, *D. Reddick* (in N. Y. State Coll. Agr. at Cornell Univ., Dept. Pl. Path. Herb., 7359).

Carolina: *H. W. Ravenel,* Fung. Car. **1**: 75 (in Mo. Bot. Gard. Herb.).

Jamaica: Cinchona, *F. S. Earle, 358* (in N. Y. Bot. Gard. Herb.).

Colorado: Fort Collins, *B. O. Longyear* (in Lloyd Mus., 12161).

Australia: Sydney, *R. T. Baker* (in Lloyd Mus., 03967).

7. Rhizopogon provincialis Tulasne, Fung. Hypog. 88. 1851.

Type: location of authentic material unknown to us.

Fructifications mostly globose to slightly irregular, 1–4.5 cm. in diameter when dry, color when fresh "yellowish white" (Tulasne), when dry Sayal brown to bister, squamulose on top; fibrils innate-appressed and scanty above, becoming prominent and almost free below, dark mummy-brown when dry; peridium thick, 400–600 μ, simplex, light orange-yellow under the microscope, composed of closely woven, small, almost hair-like, branched hyphae with blunt tips; gleba from "white to a light greenish yellow" (Tulasne) when fresh, tawny olive when dry, moderately hard; cavities subglobose to somewhat irregular, larger toward the center, the larger empty; septa 50–80 μ broad, comparatively narrow, composed of subhyaline, loosely woven hyphae, scissile; basidia clavate, 15–16$\times$7–7.5 μ, hyaline, 2–6-spored; sterigmata about as long as the spores; spores acrogenous, in mass raw sienna, under the microscope dilute yellow, ellipsoid, 6–7$\times$3–4 μ, smooth, 1–2-guttulate.

In sandy soils in mixed woods. Gardner's collection was reported under leaves of *Pinus* and *Eucalyptus*. Central Europe, California, and New Zealand. November to February.

Specimens examined:

Exsiccati: Roumeguère, Fung. Gall. Exsicc., 3825.

England: Hampshire, New Forest, *G. E. Massee,* (?) (in Mo. Bot. Gard. Herb., 5641).

France: Nice, *J. L. E. Boudier* (in Lloyd Mus., 5344); *Robert* (in Lloyd Mus., 07109); *C. Roumeguère,* Fung. Gall. Exsicc., 3825 (in Mo. Bot. Gard. Herb., 5639).

Washington: *W. N. Suksdorf, 814* (in Lloyd Mus., 7295).

California: San Francisco, *N. L. Gardner, 208* (in Zeller Herb., 1378, and Dodge Herb., 836).

New Zealand: Christchurch, *G. Brown* (in Lloyd Mus., 11476).

8. **Rhizopogon occidentalis** Zeller & Dodge, sp. nov.

Fructificationes piriformes vel irregulares, 1–4 cm. diametro metiens, citrinae recens lectae, odor massae male fermentatae (Hendersonis memoranda), "light buff" vel "mummy-brown" (Ridgway) siccatae; funiculi superne innati-applicati, prominescentes et liberi inferne, tensi et peridium constringentes, "Hessian brown" (Ridgway); peridium tenue, 60–240 μ crassitudine, simplex, byssoideum, hyphis tenuibus contextum, sub lente cremeum vel "buckthorn-brown" (Ridgway); gleba siccata, "pale yellow-orange" vel "Sudan brown" (Ridgway), fragilis; locelli globosi aut irregulares, vacui; septa circa 20–60 μ crassitudine, hyphis hyalinis contexta, scissilia; basidia late clavatae, 14×4 μ, hyalina, sterigmatibus brevibus; sporae acrogenae, ellipsoideae, cremeae, $7–9\times3–5$ μ, leves.

Habitat in terra arenoso in pinetis. America occidentalis. Veri.

Type: in Coll. N. Y. State.

Fructifications pyriform to irregular, 1–4 cm. in diameter when dry, color lemon-yellow when fresh (Henderson's field notes), drying light buff to mummy-brown; odor like sour dough or soured bread (Henderson); fibrils prominent, innate-appressed at the extreme summit, more prominent below and becoming free in the dried specimens, often stretched, constricting the peridium, color Hessian brown; peridium thin, 60–240 μ, simplex, context cottony, made up of fine hyphae, cream-colored to buckthorn-brown under the microscope; gleba pale yellow-orange to Sudan brown when dry, brittle; cavities globose to irregular, empty; septa about 20–60 μ broad, made up of hyaline hyphae, scissile; basidia broadly clavate, 14×4 μ, hyaline; sterigmata short; spores acrogenous, cream-colored, ellipsoidal, $7–9\times3–5$ μ, smooth.

In sand under conifers. Western United States. Early spring.

This species differs from *R. luteolus* in larger size, lighter color, more prominent and darker-colored fibrils, in much thinner peridium, softer context, more globose cavities, more cylindric basidia, shorter sterigmata, and lighter-colored, smaller spores.

Specimens examined:

Idaho: Moscow, *L. F. Henderson, 5168,* type (in Coll. N. Y. State).

Washington: Klickitat Co., Bingen, *W. N. Suksdorf, 630, 634, 654, 655, 656, 657, 658, 659, 662, 808, 810, 812, 813, 1004, 1030, 1031, 1035, 1039* (in Lloyd Mus., 5598, 5927, 6115, 6121, 6117, 6118, 6116, 6120, 6119, 7297, 7299, 7294, 7298, 05738, 11441, 11440, 11444, 11442, respectively, in part under the name *Rhizopogon albidus*), also *W. N. Suksdorf* (in Lloyd Mus., 7293).

Oregon: on Columbia River between Hood River and Mosier, *W. N. Suksdorf, 660* (in Lloyd Mus., 039).

California: Pacific Grove, *M. L. Sutliff* (in Coll. N. Y. State and Lloyd Mus., 05260); *W. R. Dudley, 5325* (in Coll. N. Y. State); San Francisco, *N. L. Gardner* (in Zeller Herb., 1381, and Dodge Herb., 838).

9. **Rhizopogon graveolens** (Vittadini) Tulasne, Fung. Hypog. 88. 1851; DeToni in Sacc. Syll. Fung. **7**: 162. 1888.

Hysteromyces graveolens Vittadini, Notiz. nat. e civ. sulla Lombardia **1**: 341. 1844.

Type: existence of type unknown to us.

Fructifications oblate-spheroidal to subpyriform, 1.5–4 cm. in diameter when dry, color pinkish buff to Sayal brown when dry; odor fetid (Vittadini); fibrils scanty, short, leading from base, innate-appressed, light-colored; peridium thin, 160–240 μ thick, compact, tawny under the microscope; gleba warm buff when dry, hard and brittle; cavities small, subglobose to irregular, empty; septa about 120–160 μ broad, made up of gelatinizing, branched, dilute melleus hyphae, scissile; basidia inconspicuous, clavate, $8–9\times3–4$ μ, hyaline; sterigmata about half the length of the spores; spores acrogenous, hyaline, ellipsoidal, $6–7\times3$ μ, smooth, 2-guttulate.

In dry pine woods. Italy and Alabama. January.

We were unable to locate the original description of *R. graveolens* but have based our determination on extracts from Vittadini quoted by Tulasne.

Specimen examined:

Alabama: Lee County, Auburn, *F. S. Earle* (in U. S. Dept. Agr., Bur. Pl. Ind. Path. Coll.).

10. Rhizopogon roseolus (Corda) Zeller & Dodge, comb. nov.

Splanchnomyces roseolus Corda in Sturm, Deutschl. Fl. **3**: 3–4. 1831; Icones Fung. **6**: 38. 1854.—*Rhizopogon rubescens* Tulasne, Giorn. Bot. Ital. **2**: 58. 1844 (in part), as also later writers.—*Mylitta roseola* Fries, Index Syst. Myc. 178. 1832; Summa Veg. Scand. **2**: 436 (note). 1849.

Illustrations: Corda in Sturm, Deutschl. Fl. **3**: *pl. 2;* Icones Fung. **6**: *pl. 7. f. 68;* Nees von Esenbeck, Th. F. L. & Henry, A. Syst. d. Pilze **1**: *pl. 10.*

Type: authentic specimen unknown to us, probably non-existent.

Fructifications globose to irregular, 1.5–3 cm. in diameter, cinnamon-buff to Verona brown and even blackening on drying; fibrils scanty or [illegible] appearing, innate-appressed, black when dry; peridium thin, 160–300 μ thick, compact, tawny under the microscope; gleba from warm buff to buckthorn-brown when dry, brittle; cavities subglobose and folded to labyrinthiform, empty; septa about 100 μ broad, made up of closely woven, branching, hyaline hyphae with thick gelatinized walls, not scissile; basidia ellipsoid, 12–13$\times$7 μ, with small-lumened, heavily gelatini[illegible] walls, mostly 1–2-spored, seldom 3–5; sterigmata 10–14 μ long; spores oblong to ellipsoid, acrogenous, dilute cream-colored under the microscope, heavy-walled, smooth, 2-guttulate, with an equatorially placed nucleus, making the spores appear 1-septate, 8–12$\times$3–5.5 μ.

In Europe and the United States.

While we have not studied type material of *R. roseolus,* we feel confident that this species is the one which Corda had before him when he made his drawings. Owing to certain probable inaccuracies of representation, we have thought best to present drawings from American material.

Specimens examined:

Exsiccati: Ellis, N. Am. Fung., 943; Ell. & Ev., Fung. Col., cont. Shear, 1413.

Sweden: *C. G. Lloyd* (in Lloyd Mus., 03551).

Germany: Tilsit, *W. Krüger* (in Lloyd Mus., 06438 and 05197).

Massachusetts: *S. Davis* (in Coll. N. Y. State); Amherst, *S. J. Harkness* (in N. Y. Bot. Gard. Herb., 175).

New York: Ithaca, *W. R. Dudley, 17* (in Mo. Bot. Gard. Herb., 54976, and in Atkinson Herb., 21631); *H. H. Whetzel* (in N. Y. State Coll. Agr. at Cornell Univ., Dept. Pl. Path. Herb., 598, 2275); *H. H. Whetzel & D. Reddick* (in Atkinson Herb., 19415.).

New Jersey: Iona, *G. N. Copp,* in Ellis, N. Am. Fung., 943 (in Mo. Bot. Gard. Herb., Burt Herb., and N. Y. Bot. Gard. Herb., in part [see note under *R. rubescens,* p. 20]).

Maryland: Takoma Park, *C. L. Shear,* Ell. & Ev., Fung. Col., cont. Shear, 1413 (copies in Mo. Bot. Gard. Herb., Burt Herb., and U. S. Dept. Agr., Bur. Pl. Ind. Path. Coll.).

District of Columbia: Washington, *T. C. Wilcox* (in Coll. N. Y. State).

Tennessee: Rugby, *H. M. Caldwell, 1* (in Lloyd Mus., 7463); *M. S. Percival* (in Lloyd Mus., 7139).

Florida: *G. C. Fisher* (in Lloyd Mus., 07725); De Funiak Springs, *G. C. Fisher, 9, 10, 11,* in part[1] (in Lloyd Mus., 10619); Gainesville, *N. L. T. Nelson* (in Lloyd Mus., 171).

Alabama: Montgomery, *R. P. Burke* (in Lloyd Mus., 3 [or 4]); Spring Hill, *A. S. Bertholet* (in Lloyd Mus., 7127); Auburn, *G. F. Atkinson, 1038* (in Atkinson Herb.).

Mississippi: Ocean Springs, *H. G. McGowan* (in Lloyd Mus., 05812).

British Columbia: *J. U. Lloyd* (in Lloyd Mus., 6411).

11. Rhizopogon induratus Cooke, Grevillea **8**: 59. 1879.

Type: probably in Kew Herb.

Fructifications gregarious, depressed globose to irregular, "diameter 1–4 cm., color white, then pinkish, becoming dirty yellow or olivaceous" (McMurphy's field notes), drying black; fibrils inconspicuous to wanting above, large, free, rhizomorph-like below, often uniting several fructifications,

[1] Mr. Lloyd has these three numbers under the same number, some of the material being *Rhizopogon rubescens.*

concolorous with peridium or darker; peridium thin, 60–200 μ thick, simplex, context compact beneath, with cottony surface made up of branched brown hyphae 5–6.5 μ in diameter, claret-brown under the microscope; gleba at first white, then brownish olive, soft like heavy dough, finally drying hard like putty; cavities small, very irregular, mostly long-winding, about 60 μ in short diameter, filled with spores; septa narrow, 10–13 μ broad, hyaline, compact, not scissile; basidia inconspicuous, hyaline, 1–2-spored; sterigmata about one-half as long as spores; spores acrogenous, hyaline, ellipsoidal to narrowly ovate, 8–10×3–5 μ, 1–2-guttulate, smooth, granular, with large nuclei mostly equatorially placed.

Emersed or submersed. Pacific coast, Australia, and New Zealand. November to March.

In the specimens examined, the peridium is thin, and the spores average larger than in Cooke's description, and Cooke describes the gleba as cinereous-fuscous, while in our specimens it is brownish olive.

Specimens examined:

Washington: Klickitat Co., Falcon Valley, *W. N. Suksdorf, 1001* (in Lloyd Mus., 05737).

California: Palo Alto, *J. McMurphy* (in Dudley Herb. at Leland Stanford Jr. Univ., Zeller Herb., 1405, and Dodge Herb., 838).

Australia: Sydney, Gladesville, *M. Flockton* (in Lloyd Mus., 11509).

12. Rhizopogon rubescens Tulasne, Giorn. Bot. Ital. **2**: 58. 1844; Fung. Hypog. 89–91. 1851; DeToni in Sacc. Syll. Fung. **7**: 161–162. 1888; Hesse, Hypog. Deutschl. **1**: 92–94. 1891.

Hysterangium rubescens Tulasne, Ann. Sci. Nat. II. **19**: 375. 1843.—*Rhizopogon luteolus* Krombholz, Nat. Abbild. u. Beschr. Schwämme **8**: 21. *pl. 60. f. 13–15.* 1843.—*Melanogaster Berkeleyanus* Broome, Ann. Mag. Nat. Hist. I. **15**: 41. 1845. —Not *Splanchnomyces roseolus* Corda in Sturm, Deutschl. Fl. **3**: 3–4. *pl. 2.* 1831.

Illustrations: Rehsteiner, Bot. Zeit. **50**: *pl. 11;* Tulasne, Fung. Hypog. *pl. 2. f. 1, pl. 11. f. 4.*

Type: location unknown to us.

Fructifications cespitose, ovate, or irregularly globose, 1–6 cm. in diameter when fresh, 1–5 cm. when dry, color white at first, then livid yellow, reddening in air (Tulasne), and drying Morocco red to claret-brown or almost black where touched; odor weak or almost none (Tulasne); fibrils inconspicuous, innate-appressed above, simple, large, rhizomorph-like below, at first white (Tulasne), then reddening and becoming almost black; peridium thin, about 160–220 μ, simplex, compact, brittle, very dark tawny; gleba at first white (Tulasne), then melleus to Isabella-color, brittle; cavities subglobose to labyrinthiform and irregularly crowded, empty; septa narrow, about 40–50 μ broad, hyaline, usually not scissile until old; basidia pyriform or clavate, 2–8-spored, 12–14 μ long; sterigmata about as long as the spores; spores acrogenous, ochraceous-tawny in mass, hyaline or cream-colored under the microscope, ellipsoidal, $5–10 \times 3–4.5$ μ, 1–2-guttulate, smooth.

In sand under pines. Cosmopolitan. Autumn or winter, according to latitude.

Specimens examined:

Exsiccati: Roumeguère, Fung. Gall. Exsicc., 3826, under the name *Rhizopogon provincialis;* Ellis, N. Am. Fung., 943 (in U. S. Dept. Agr., Bur. Pl. Ind. Path. Coll., but not copies in Mo. Bot. Gard. Herb. nor in Burt Herb.).

Sweden: *C. G. Lloyd* (in Lloyd Mus., 03757).

Germany: Brandenburg, *O. Jaap, 12* (in Lloyd Mus., 03904).

England: Hampshire, Lundhurst, *C. E. Broome* (in Lloyd Mus., 1279).

France: Nice, *C. Roumeguère,* in Roumeguère, Fung. Gall. Exsicc., 3826 (in Mo. Bot. Gard. Herb., 5640); *Barla* (in Lloyd Mus., 5334).

Italy: Verona, S. Manro d' Saline, *C. Massalongo, 5* (in Lloyd Mus., 06084); Como, *O. Mattirolo, 8* (in Lloyd Mus., 03718).

Massachusetts: Boston, *H. Page* (in Lloyd Mus., 5899, 5900).

New York: Albany Co., Karner, *C. H. Peck* (in Coll. N. Y. State); Ithaca (in Atkinson Herb., 14053).

New Jersey: (in Lloyd Mus., 6179); Bakersville, *Mrs. G. M. Dallas* (in Lloyd Mus., 05881); Newfield, *J. B. Ellis,* Nov., 1879, Sept., 1880, Nov., 1881 (in N. Y. Bot. Gard. Herb., 175, in part); Iona, *G. N. Copp* (in N. Y. Bot. Gard. Herb., 175, in part), also issued as Ellis, N. Am. Fungi, 943[1] (in U. S. Dept. Agr., Bur. Pl. Ind. Path. Coll., but not in copies in Mo. Bot. Gard. Herb. nor Burt Herb.).

District of Columbia: Washington, *F. J. Braendle* (in Lloyd Mus., 05229).

Tennessee: Rugby, *H. M. Caldwell* (in Lloyd Mus., 7163); *Mrs. M. S. Percival* (in Lloyd Mus., 7119).

North Carolina: *M. A. Curtis* (in U. S. Nat. Herb.); Waynesville, *M. Fitzgerald* (in Lloyd Mus., 04216).

Florida: *G. C. Fisher, 2, 21* (in Lloyd Mus., 08355, 07866, respectively); De Funiak Springs, *G. C. Fisher* (in Lloyd Mus., 10621, 10619 in part [see note p. 17]); Cocoanut Grove, *A. S. Bertholet* (in Burt Herb.).

Alabama: Auburn, *F. S. Earle,* two collections (in N. Y. Bot. Gard. Herb.).

Texas: *Mrs. M. J. Young* (in N. Y. Bot. Gard. Herb.).

Iowa: Iowa City, *T. H. McBride* (in Lloyd Mus., 20 Hypogaei).

Washington: Cheney, *S. Tucker* (in Lloyd Mus., 08243).

California: Asilomar, *Walden & Cowles* (in Lloyd Mus., 1654, probably also in Pomona Coll. Herb., 1654); Pacific Grove, *M. L. Sutliff* (in Coll. N. Y. State); San Francisco, *N. L. Gardner* (in Zeller Herb., 1379, and Dodge Herb., 839).

Chile: Santiago, *M. Espinosa* (in Lloyd Mus., 5).

Japan: Sendai, *A. Yasuda, 166* (in Lloyd Mus., 13166).

West Australia: Leadersville, *F. Stoward, 9* (in Lloyd Mus.).

12a. Var. **Vittadinii** Tulasne, Fung. Hypog. 89. 1851.

[1] Ellis evidently mixed the collections which appear as "N. Y. Bot. Gard. Herb., 175" while they were still in his herbarium. Probably one collection was *R. roseolus* and the others *R. rubescens,* and the sets of the 'North American Fungi' were made up from the mixture. The portion studied was evidently put into a separate envelope, while the surplus material was placed in the box which contains a large number of fructifications, some of which are *R. roseolus* and some *R. rubescens.*

Hysteromyces vulgaris Vittadini, Notiz. nat. e civ. sulla Lombardia **1** : 341. 1844.

Type: unknown to us.

This variety differs from *R. rubescens* in that it has a thicker peridium (260–400 μ) which does not redden so distinctly on exposure to the air; the spores are smaller (6–8×3 μ); septa mostly as in *R. rubescens* but occasionally scissile. The hyphae of the fibrils are brown and septate with clamp connections.

Specimens examined:

Italy: Trentino, Coredo, Val d'Non, *M. Bezzi* (in Lloyd Mus., 08739).

Massachusetts: Boston, *S. Davis* (in Lloyd Mus., 5914, under the name *Rhizopogon roseus* Bresadola in herb., 5915).

Maryland: Georgetown, *H. H. Whetzel & Rhoads* (in Fitzpatrick Herb., 1152, N. Y. State Coll. Agr. at Cornell Univ., Dept. Pl. Path. Herb., 10158, Zeller Herb., 1406, and in Dodge Herb., 840).

Texas: Houston, *G. L. Fisher, 64* (in Lloyd Mus., 64).

Washington: Bingen, *W. N. Suksdorf, 807, 809* (in Lloyd Mus., 7296 and 7301, respectively).

EXTRA-LIMITAL SPECIES

The following are descriptions of species of *Rhizopogon* not as yet found in North America, but are included in order to assist in referring material to them in case they should be discovered later, as the individual species are found to have a very wide range. The descriptions in which no specimens are cited as having been examined, are compiled from the original descriptions, except as otherwise noted, and are translations or copies of them. As no material referable to them has been examined nor the types studied, we can form no opinion as to their validity.

1. **Rhizopogon violaceus** Cooke & Massee, Grev. **21** : 1. 1892; Saccardo, Syll. Fung. **11** : 170. 1895.

Type: *Kirk, 382* in Kew Herb. not studied.

Fructifications globose, drying angular, diameter up to 2.5 cm. when dry, vinaceous-fawn to fawn-color; no indica-

tion of fibrils; peridium very thick, 1–1.3 mm., simplex, coriaceous, very compact, made up of closely woven, very small hyphae, hyaline except for the violet bloom at the surface; gleba buffy citrine to Saccardo's olive; cavities globose to irregular, empty; septa about 75 μ in thickness, made up of closely woven, hyaline hyphae, not scissile; basidia clavate, inconspicuous, 7.5×15 μ, hyaline; sterigmata half as long as the spores; spores acrogenous, olivaceous in mass, oblong-ellipsoidal, $6–7 \times 3–4$ μ.

Submersed or partially emersed. Australia, New Zealand, and Japan.

This species is a very striking one. The gleba of dried specimens has a powdery appearance when cut, which, together with its very thick peridium, would lead one to place it in *Scleroderma*. The gleba cracks off from the peridium very readily when dry, and a study of sections shows a very definite cleavage plane formed by a layer of pseudoparenchyma between the gleba and the peridium. This feature suggests *Hysterangium* and would lead one to place it there as that genus was understood by DeToni in Saccardo, but there is no indication of a base or columella, which is considered an essential of this genus as understood by Tulasne and by Fisher in Engler & Prantl.

Specimens examined:

Australia: Victoria, Follett Co., *F. M. Reader, 8* (in Lloyd Mus., 06151).

Japan: Negoya, *J. Umemura* (in Lloyd Mus., 164, under the name *Hysterangium Phillipsii*).

2. **Rhizopogon Rodwayi** MacAlpine, Agr. Gaz. N. S. Wales **6**: 11. 1895; Saccardo, Syll. Fung. **14**: 267–268. 1899.

Illustration: MacAlpine, Agr. Gaz. N. S. Wales **6**: *pl. 4. f. 1–5.*

Type: location unknown to us.

Fructifications oblong, tuberiform, irregular, length up to 4 cm. (teste MacAlpine), 2–2.5 cm. broad, color from light pinkish cinnamon to cinnamon; fibrils very large, loose, prominent but scanty, concolorous or somewhat darker; peridium

variable in thickness from 90 to 180 μ in the same fructification, context cottony, made up of fine, brown hyphae loosely interwoven; gleba from pale ochraceous-salmon to zinc-orange; cavities globose to irregular, empty; septa 50–60 μ thick, hyaline, compact, not scissile; basidia inconspicuous, cylindrical, about 3 μ in diameter; sterigmata half the length of the spores; spores acrogenous, ellipsoidal, hyaline, smooth, 3–4$\times$1 μ.

Hypogaeous. Tasmania and Australia.

Specimens examined:

Australia: Sydney, Gladesville, *M. Flockton* (in Lloyd Mus., 11509).

3. **Rhizopogon suavis** Quelet, Grev. **8**: 116. 1880; Assoc. Fr. Av. Sci. **12**: 508. 1883 (often cited as Champ. du Jura et des Vosges, Supplement **12**: 11. 1883); DeToni in Sacc. Syll. Fung. **7**: 163. 1888.

Illustrations: Quelet, Grev. **8**: *pl. 131. f. 3;* Assoc. Fr. Av. Sci. **12**: *pl. 7. f. 1* (Champ. du Jura et des Vosges, Suppl. **12**: *pl. 7. f. 1*).

Oblong, bullate, 1 cm. in diameter, tomentose, pale yellow (changing to brown when exposed to the air), adhering to chestnut-coloured fibres, which terminate in an arachnoid net; substance *compact,* elastic, hyaline, then olive, giving out a delicate odour of honey; cells rounded, with thin, white, silky walls; spores (5–7 on each basidium) pruniform, 5–7 μ, ochraceous, with two nuclei.

Summer. Woods on the lower hills of the Jura.

In the original description the diameter is given as "(.0–.01 mm.)," evidently a mistake, as the French version three years later gives it as "0^{m}, 01," i. e., 1 cm. The original gives the spores as "(.0005–.7 mm.)," the French as "(0^{mm}, 005–7)" now usually written "5–7 μ."

O. Jaap distributed as 'Flora der Provinz Brandenburg, 9,' under the name of *Rhizopogon virens* (A. & Schw.) from Triglitz i. d. Prignitz. This, however, is not *R. virens* as usually understood by European authors, and may be referred to *R. suavis* Quel., but we have seen no authentic material.

The description is rather too general to use in the identification of dried material. The specimen referred to above is the Lloyd Museum No. 03849. A collection in the Lloyd Museum from T. de Aranzadi, Barcelona, Spain, is conspecific with the above specimen.

4. Rhizopogon angustisepta Zeller & Dodge, sp. nov.

Fructificationes globosae vel irregulares, 0.8–1.0 cm. diametro siccatae metiens, "vinaceous-russet" vel "chocolate" aut etiam "Vandyke brown" (Ridgway), violaceo cum colore immixta; funiculi innati-applicati, fere nigri; peridium 460 μ crassitudine, duplex, strato extero 60–80 μ crassitudine, "ochraceous-buff" (Ridgway), minutis hyphis compacto, strato intero 380–400 μ crassitudine, "Mars brown" (Ridgway), hyphis maioribus granularibus contexto; gleba "cinnamon-brown" (Ridgway); locelli minuti, irregulares, vacui; septa pseudo-parenchymate compacta, 20–25 μ crassitudine inter hymenia; basidia hyalina in matrice gelatinosa, aequale cum superficie insita, ellipsoidea, di- vel tetraspora, sterigmatibus ex matrice proicientibus tam longis quam sporis; sporae ellipsoideae vel fusiformes, hyalinae, leves, 6–8$\times$2–3 μ.

Habitat in Tilsit, Germania.

Type: in Lloyd Museum.

Fructifications globose to irregular, drying to 0.8–1.0 cm. in diameter, from vinaceous-russet to chocolate and even Vandyke brown with a violaceous tint; fibrils quite conspicuous, innate-appressed, almost black; peridium 460 μ thick, duplex, outer layer 60–80 μ thick, ochraceous-buff, of very fine compacted hyphae, inner layer 380–400 μ thick, Mars brown, of coarser granular hyphae; gleba cinnamon-brown; cavities small, irregular, empty; septa compact, composed of a very tight pseudo-parenchyma, 20–25 μ broad, not including the hymenium; basidia hyaline, embedded in a gelatinous matrix with an even surface, ellipsoidal, 2–4-spored; sterigmata protruding from the matrix, about as long as the spores; spores ellipsoidal to fusiform, hyaline, 6–8$\times$2–3 μ.

In East Prussia.

Specimens examined:

Germany: East Prussia, *Wm. Krüger,* type (in Lloyd Mus., 6692, Dodge Herb., 833, and Zeller Herb., 1437).

5. Rhizopogon rubrocorticeus Zeller & Dodge, sp. nov.

Fructificationes globosae, 1.7–3.7 cm. diametro metiens, servatae "Hessian brown" (Ridgway) saepe cum "coral-pink" (Ridgway) maculis, siccatae "Verona brown" vel "snuff-brown" (Ridgway), tactu nigrescentes; funiculi pauci, liberi, subramosi, prominentes, "Hessian brown" (Ridgway) vel saturatiores; peridium crassum, 600–800 μ crassitudine, simplex, "russet" vel "ox-blood-red" et "claret-brown" (Ridgway), hyphis septatis, granulis coloratis impletis, contextum; gleba albida recens, "light buff" (Ridgway) sicca; locelli irregulares, vacui aut nonnulla ex parte recens impleti; septa hyalina, 60–70 μ crassitudine, cellulis pseudoparenchymatibus confecta, non scissilia; basidia late ovate, 6–10$\times$10–13 μ, sterigmatibus 3–6 μ longitudine munita; sporae acrogenae, "cream-buff" (Ridgway) acervatae, ellipsoideae, 5–6.5$\times$3–4 μ, saepe diguttulatae.

Habitat in Mauritio Insula.

Type: in Lloyd Museum, Zeller Herb., and Dodge Herb.

Fructifications globose, 1.7–3.7 cm. in diameter, with a distinct reddish appearance in preserved specimens, Hessian brown (often with spots of coral-pink), on drying becoming Verona brown to snuff-brown and almost black where bruised; fibrils few, free, somewhat branched, very prominent, Hessian brown to darker; peridium 600–800 μ thick, simplex, russet to ox-blood-red and claret-brown, of septate hyphae containing pigmented granules; gleba white when fresh, drying to light buff; cavities irregular, medium size, empty or partially filled when young; septa hyaline, 60–70 μ broad, compact, composed of pseudo-parenchyma, not scissile; basidia hyaline, broadly ovate, 6–10$\times$10–13 μ; sterigmata about as long as the spores; spores cream-buff in mass, appearing hyaline when alone, ellipsoidal, mostly 2-guttulate, 5–6.5$\times$3–4 μ.

In Mauritius.

Specimens examined:

Mauritius: Le Reduit Gardens, *C. A. O'Connor* (in Lloyd Mus., 06217, type, 06316, and 12191, under the name *Anthracophlous rhizopogonoides.*

6. Rhizopogon Briardi Boudier, Bull. Soc. Bot. France **32**: 284–285. 1885; Icones Myc. **4**: 97. 1911; De Toni in Sacc. Syll. Fung. **7**: 163. 1888.

Illustrations: Boudier, Bull. Soc. Bot. France **32**: *pl. 9. f. 5;* Icones Myc. **1**: *pl. 190.*

Type: unknown to us.

Fructifications globose to irregular, 1–2.5 cm. in diameter, apricot-buff to Hay's russet; fibrils scanty, inconspicuous, innate-appressed, darker than the peridium; peridium 440–580 μ thick, duplex, outer layer warm buff under the microscope, about 240 μ thick, composed of loosely woven hyphae, easily separable, leaving inconspicuous patches, inner layer madder-brown under the microscope, about 200–340 μ thick, composed of a stupose mat of hyphae; gleba tawny to russet; cavities globose to irregular, medium size, empty; septa hyaline, about 40 μ broad, composed of pseudo-parenchyma; basidia inconspicuous, hyaline; sterigmata short; spores honey-yellow in mass, appearing light creamy singly, 1–2-guttulate, 6.5–8$\times$ 3.5–5 μ.

Specimens examined:

Exsiccati: Roumeguère, Fung. Gall. Exsicc., 3661.

Sweden: *L. Romell* (in Lloyd Mus., 04351).

France: Champagne, near Troyes, *Major Briard,* in Roumeguère, Fung. Gall. Exsicc., 3661 (in N. Y. Bot. Gard. Herb.); Aube, *L. Hemet* (in Lloyd Mus., 10734).

Austria: Tyrol, Mendel Pass, *G. Bresadola & W. A. Murrill* (in N. Y. Bot. Gard. Herb.).

7. **Rhizopogon virescens** Karsten in Sacc. Syll. Fung. **9**: 280. 1891.

Rhizopogon virens Karsten, Finska Vet.-Soc. Bidrag Natur och Folk **25**: 354–355. 1876 (or Myc. Fenn. **3**: 354–355. 1876); *Ibid.* **48**: 18–19. 1889 (or Krit. Öfversigt af Finl. Basidsv. 18–19. 1889).—But not of other authors.

Peridium lobate, difform, commonly oblong-sphaeroidal, bearded with loose, radicating fibrils below, at first white, then dirty spadiceous, becoming greenish ashy within; spores oblong, straight, smooth, 10–16$\times$4–6 μ.

Habitat: in pine woods by sandy roadside. Syrjöås, near Mustiala. August and September, 1865 and 1870.

Infrequent. Odorless. Diam. 1.5 cm.

8. **Rhizopogon lapponicus** Karsten, Finska Vet.-Soc. Bidrag Natur och Folk **48** : 19. 1889 (or Krit. Öfversigt af Finl. Basidsv. 19. 1889); Saccardo, Syll. Fung. **9** : 280. 1891.

Rhizopogon luteolus Karsten, Finska Vet.-Soc. Bidrag Natur och Folk **25** : 354. 1876 (or Myc. Fenn. **3** : 354. 1876).

Peridium difform, commonly sphaeroid, reniform or ovoid, with loose, radicating fibrils, at first white, then light yellow or dirty yellow, within becoming yellow; spores ellipsoid, dilute yellowish or subhyaline, smooth, straight, 7–10×4–5 μ. . . . .

Hab. wooded areas in earth, very rare. So far, I have collected it on the Island Runsala near Åbo and at Knäsäguba in southern Russian Lapponia. Summer and autumn.

—Karsten.

Sparse or gregarious. About 2 cm. in diameter. Odor and taste nauseous.

There seems little in the above description to distinguish it from *R. rubescens*. The type should be carefully studied.

9. **Rhizopogon Webbii** Tulasne, Fung. Hypog. 91. 1851; De Toni in Sacc. Syll. Fung. **7** : 164. 1888.

Rhizopogon albus Montagne in Webb & Bertholet, Hist. Nat. des Iles Canar. III. **2**[4]: 85. 1841.—*Splanchnomyces Webbiana* Corda, Icones Fung. **6** : 40. 1854.

Illustrations: Corda, Icones Fung. **6** : *pl. 8. f. 74.*

Fructification rotund, difform, lobate-depressed, confluent, smooth, from white becoming brown, with fibrillose base, 2–2.5 cm. in diameter; peridium testaceous-fulvous, smooth, thin; gleba fulvous-alutaceous, firm, compact; cavities narrow, bent, meandriform; septa pale luteous, homogeneous; hymenium greenish; sterigmata short; spores cylindric, ellipsoid, smooth, rounded at each end, olivaceous, .0003 p. p. p. long (teste Corda).

Habitat: under fallen leaves of *Pinus canariensis* in high places, Chasna and elsewhere in the Canary Islands. Edible.

The above description was drawn up from a combination of the references given above. Both Montagne and Tulasne state that the specimens, preserved in alcohol, were sterile and young. The Corda description was probably drawn up by

Zobel, who edited the final volume of the 'Icones' after Corda's death. Zobel states that the description is based on a specimen received from Montagne.

10. Rhizopogon piceus Berk. & Curt. Am. Acad. Arts & Sci. Proc. **4** : 124. 1860 (often cited as Fung. N. Pac. Exped. No. 114); De Toni in Sacc. Syll. Fung. **7** : 163–164. 1888.

Beardless, peridium at length black; gleba alutaceous-umber; spores oblong.

Habitat: mountain valleys near Hong Kong, China.

This very brief description must await a study of the type material before it will be a usable species name.

11. Rhizopogon borealis Karsten, Soc. pro Fauna et Fl. Fenn. Meddel. **13** : 161–162. 1886 (or Symb. Myc. Fenn. **17** : 161–162. 1886); Finska Vet.-Soc. Bidrag Natur och Folk **48** : 19–20. 1889 (or Krit. Öfversigt af Finl. Basidsv. 19–20. 1889); De Toni in Sacc. Syll. Fung. **7** : 164. 1888.

Peridium difform, unequal, white, brown on drying, testaceous or lurid within, fleshy, without fibrils (?) (nuda), at least when dry, 2–3 cm. in diameter; spores oblong or ellipsoid, 2- or rarely 4-guttulate, hyaline, straight, 5–8×2–3 μ.

In sandy soil near Ulaburg (*H. S. Zidbäck*).

12. Rhizopogon aestivus Fries, Syst. Myc. **2** : 294. 1823.

Lycoperdon aestivum Wulfen, Pl. Rar. Carinth. **5** : No. 133, in Jacquin, Coll. Bot. Chem. Hist. Nat. **1** : 349–351. 1786.

This species is given by Tulasne as a synonym of *R. rubescens* in his original description and antedates it by twenty years, but it seems unwise to reduce *R. rubescens* to synonymy until the types can be studied, especially since the latter name has been the only one in use since it was proposed in 1844. The Friesian description is in such general terms that it would apply to several different species.

13. Rhizopogon virens (Albertini & Schweinitz) Fries, Syst. Myc. **2** : 294. 1823.

Tuber virens Albertini & Schweinitz, Consp. Fung. Lusat. 77. *pl. 8. f. 3.* 1805.

This species has had such a varied history that only a careful study of types can untangle the synonymy. The plate cited above and early descriptions seem to make it synonymous with *R. luteolus* Fr. & Nordh. which it antedates by ten years. Writers from Tulasne to DeToni include it among the synonyms of that species. Hesse thinks it a separate species.

14. Rhizopogon albus Fries, Syst. Myc. **2** : 293–294. 1823.

As in the preceding, the synonymy here is very involved, and type material must be studied. The Friesian species is usually said to be an ascomycete, but as we have been unable to find it reduced to synonymy until all the other descriptions of *Rhizopogon albus* were published, this seems to prevent the use of *R. albus* to designate other species, and they have mostly been transferred or renamed. (See excluded species.)

15. Rhizopogon dubius (Corda) DeToni in Sacc. Syll. Fung. **7** : 164. 1888.

Splanchnomyces dubius Corda, Icones Fung. **6** : 38. 1854.

Illustration: Corda, Icones Fung. **6** : *pl. 7. f. 70.*

This is for me a doubtful species; I have not seen it, and it could not be found among Corda's specimens; Corda did not make a drawing of the whole fungus as he usually did, and his original drawing shows only what is reproduced here. Only the spore size is noted in Corda's handwriting, 3.4–3.9 μ.

I can only inform my readers that as may be seen from the drawing, the (smooth) peridium may be dirty purple red, the septa dirty yellow, the hymenium bright yellow, the spores colorless. . . . .

I suppose that Corda had only a fragment of this fungus to work with. It probably grows in Böhmen.

The almost pure yellow of the gleba and the narrow, labyrinthiform cavities separate this species from the previous and the following ones. —Zobel.

EXCLUDED SPECIES

1. Rhizopogon albus Berkeley in Smith, Brit. Fl. **5**[2]: 299. 1836, is *Hymenogaster Klotzschii* Tulasne Fung. Hypog. 64–65. 1851.

2. Rhizopogon albus Corda in Sturm, Deutschl. Fl. Abt. III. Heft 19–20 : 43–46. *pl. 14.* 1841, is *Choeromyces meandriformis* Vittadini, Mon. Tub. 51. *pl. 2. f. 1, pl. 4. f. 10.* 1831.

3. **Rhizopogon Leonis** Payer, Bot. Crypt. 100. *f. 462.* 1850, is *Terfezia Leonis* Tulasne, Ann. Sci. Nat. III. **3** : 350. 1845; and in Durieu de Maison-Neuve, Expl. Sci. de l'Alg. Bot. **1** : 432. *pl. 24. f. 22–30.* 1846–1849.

4. **Hydnangium aurantium** (Harkness) Zeller & Dodge, comb. nov.

Rhizopogon aurantius Harkness, Proc. Cal. Acad. Sci. III. **1** : 257. 1899; Saccardo, Syll. Fung. **16** : 251. 1902.

Type: in Dudley Herb. at Leland Stanford Jr. Univ.

Fructifications solitary, subglobose, 2 cm. in diameter, "dirty white when fresh" (Harkness), drying yellowish (the specimens in alcohol, however, are dark brown); peridium 180–200 μ thick, homogeneous, but outer hyphae becoming brown; gleba "orange when fresh" (Harkness), now (Dec., 1917) auburn when wet with alcohol, becoming pale orange-yellow when drying out; cavities globose, large in the center, empty; septa 150 μ thick, composed of gelatinizing, closely woven, hyaline hyphae, scissile; basidia clavate, hyaline, gelatinous, 2–8-spored; sterigmata 10–11 μ long, slender; spores dilute olivaceous to subhyaline, rough, globose, 15 μ in diameter (8–10 μ, teste Harkness).

In dense forests of *Sequoia.* California. August.

Specimens examined:

California: Marin County, Mt. Tamalpais, *H. W. Harkness, 74,* type (in Dudley Herb. at Leland Stanford Jr. Univ.).

EXPLANATION OF PLATE

PLATE 1

Fructifications of species of *Rhizopogon* (natural size).

Fig. 1. *R. provincialis* showing the prominent, free fibrils.

Fig. 2. *R. graveolens* showing the characteristic surface and usual shape of the fructifications.

Fig. 3. *R. maculatus* showing fibrils.

Fig. 4. *R. luteolus* showing the innate fibrils.

Fig. 5. *R. roseolus* showing the dark peridium and scanty fibrils.

Fig. 6. *R. pannosus* showing the "patches" or remains of the outer peridium.

Fig. 7. *R. occidentalis* showing the prominent, innate-appressed fibrils.

Fig. 8. A fructification of *R. pachyphloeus* showing both the black cut surface and the external surface with reticulated, innate fibrils.

Fig. 9. *R. rubescens* var. *Vittadinii* showing the nature of the fibrils.

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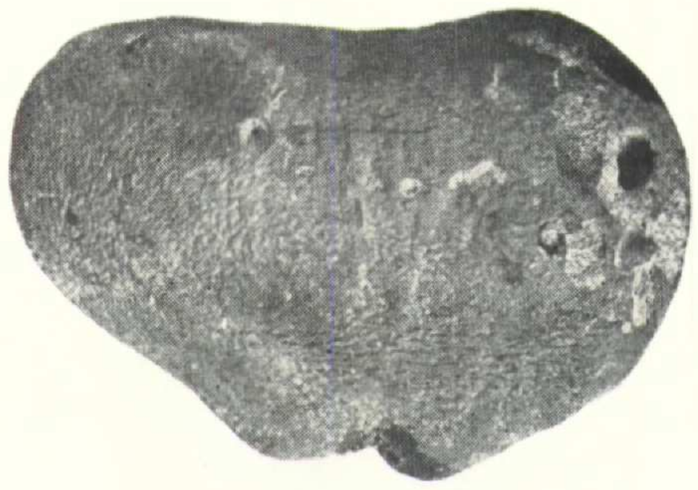

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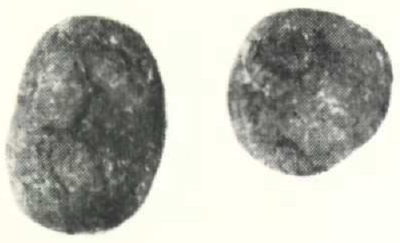

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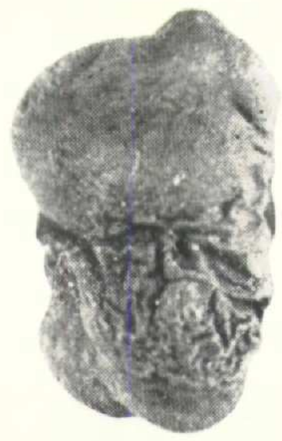

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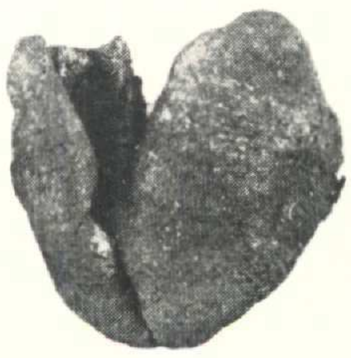

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9

ZELLER AND DODGE—RHIZOPOGON

EXPLANATION OF PLATE

PLATE 2

Fig. 1. Diagrammatic section of *Rhizopogon maculatus*, showing the duplex character of the peridium and its relation to the gleba; × 120.

Fig. 2. Basidia of *R. maculatus;* × 800.

Fig. 3. Diagrammatic section of *R. pannosus*, showing the duplex peridium, the cracking of the outer layer to form the "patches," and the relation of the peridium and gleba; × 10.

Fig. 4. Basidia of *R. pannosus;* × 830.

Fig. 5. Diagrammatic section of *R. diplophloeus*, showing general relation of parts; × 10.

Fig. 6. Showing bulbous hyphae of the outer peridial layer of *R. diplophloeus;* × 200.

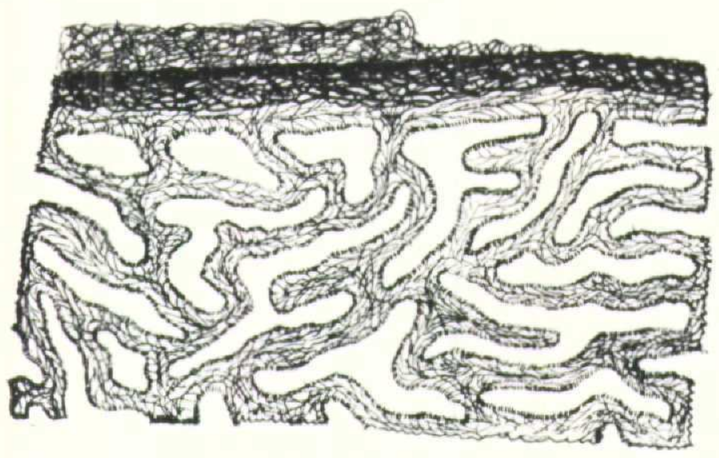
Fig. 7. Basidia of *R. diplophloeus;* × 800.

Fig. 8. Diagrammatic section of *R. pachyphloeus;* × 10.

Fig. 9. Basidia and spores of *R. pachyphloeus;* × 800.

Fig. 10. Diagrammatic section of *R. occidentalis*, showing the relation of the peridium to the gleba and the scissile character of the septa; × 30.

Fig. 11. Basidia of *R. occidentalis;* × 800.



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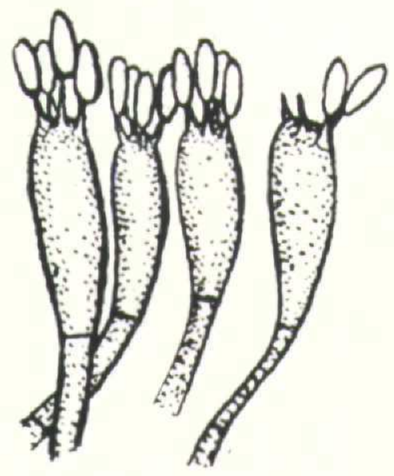

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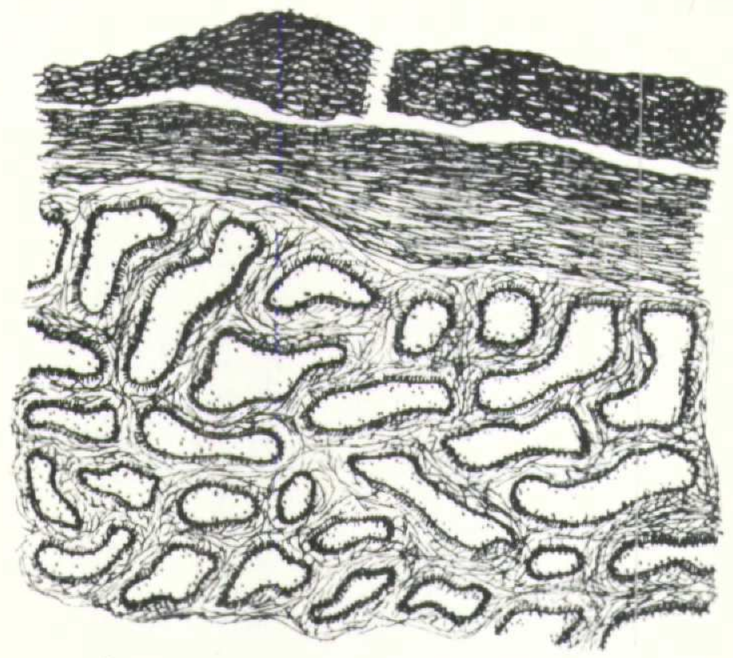

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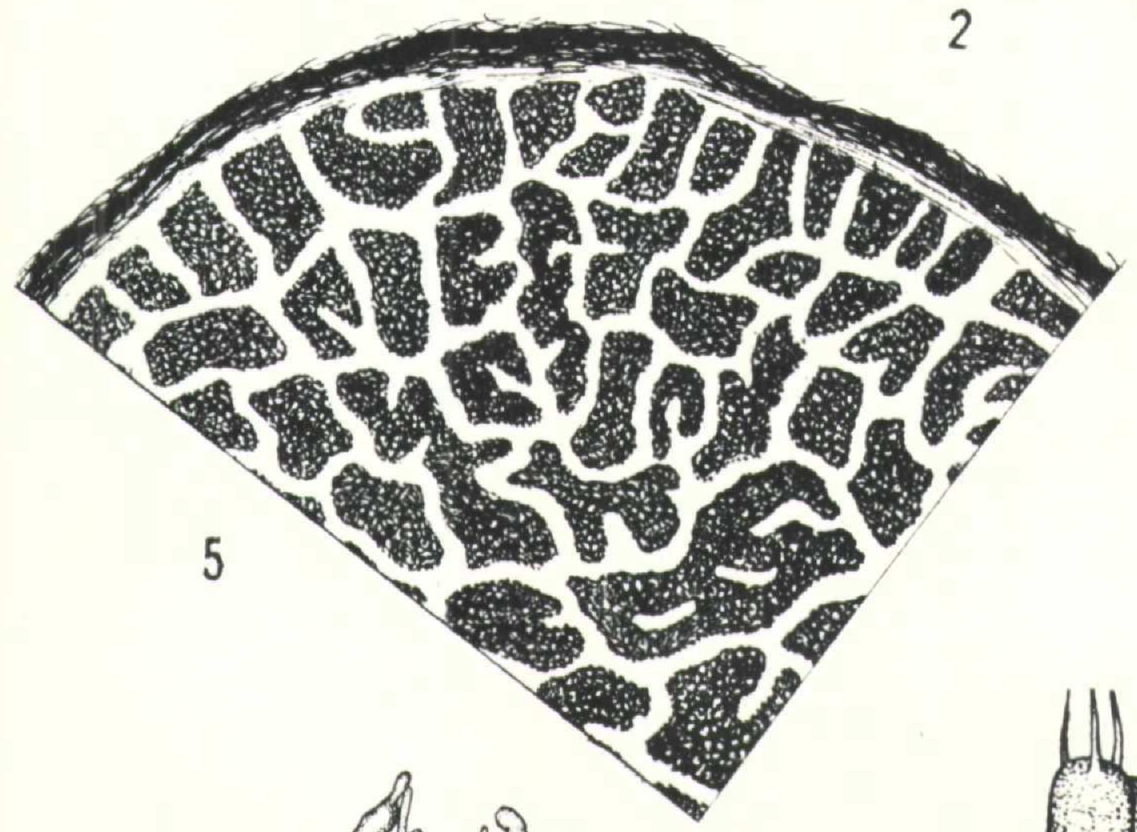

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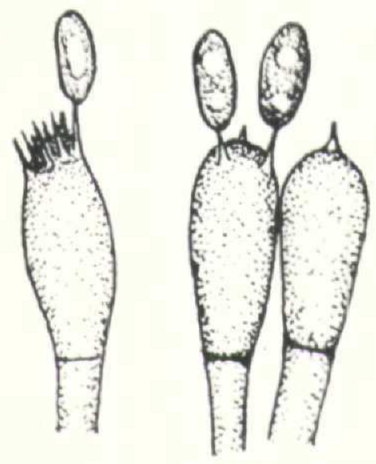

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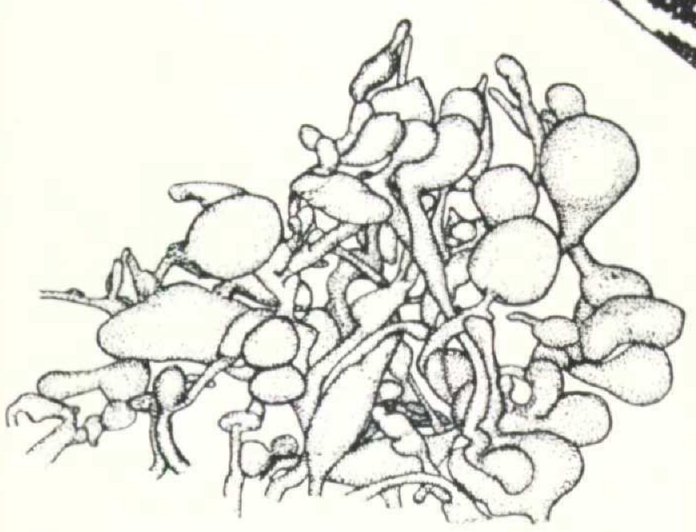

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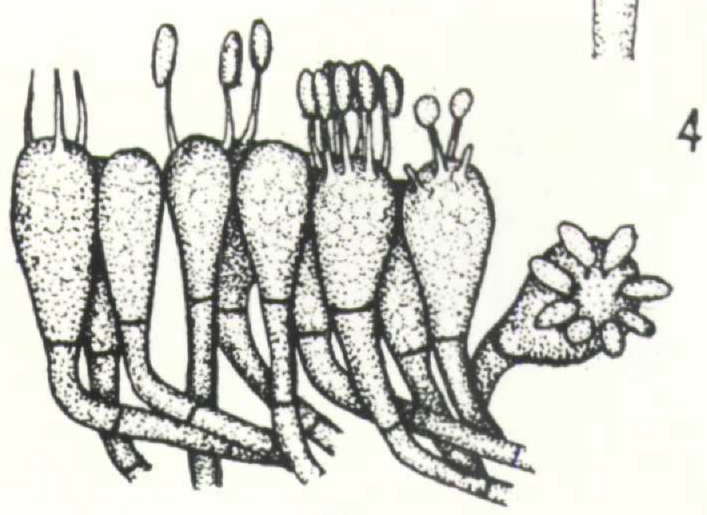

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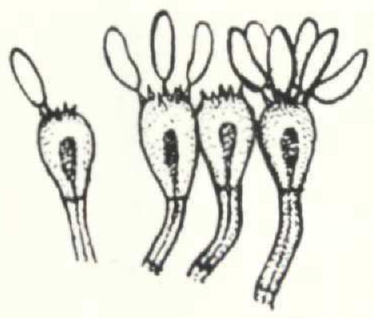

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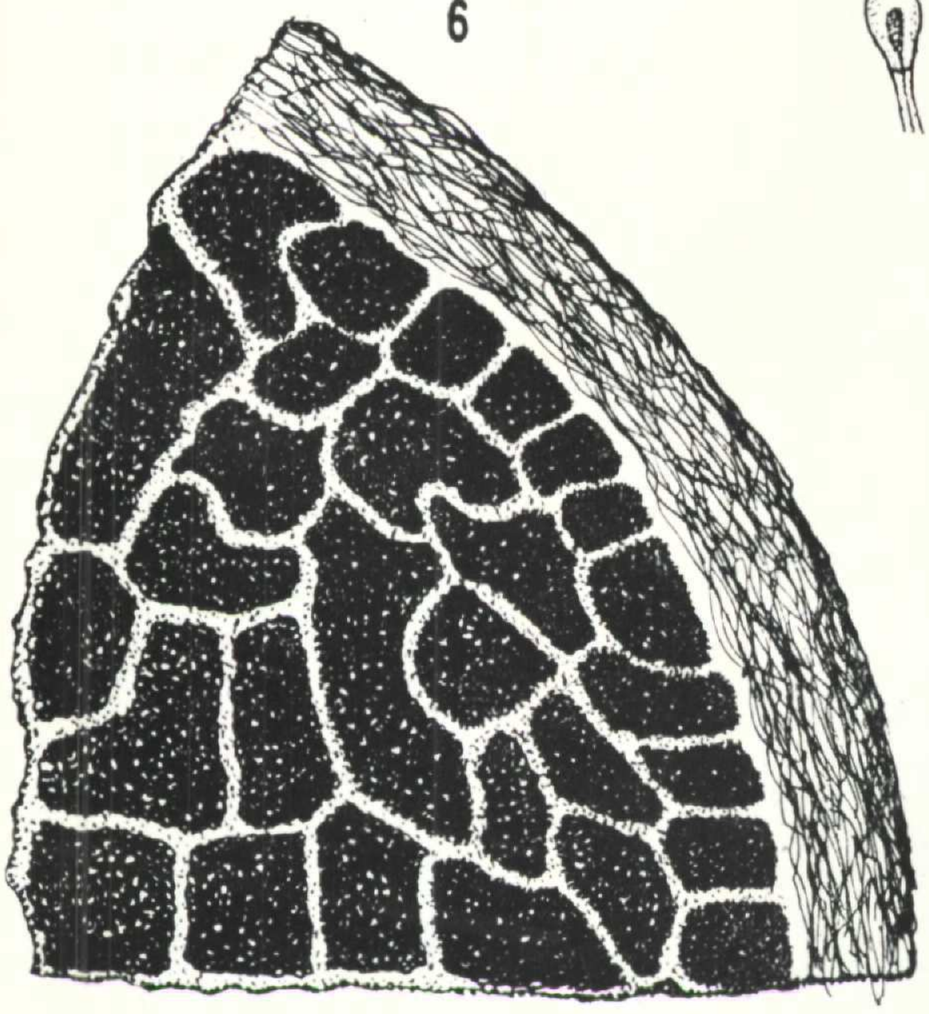

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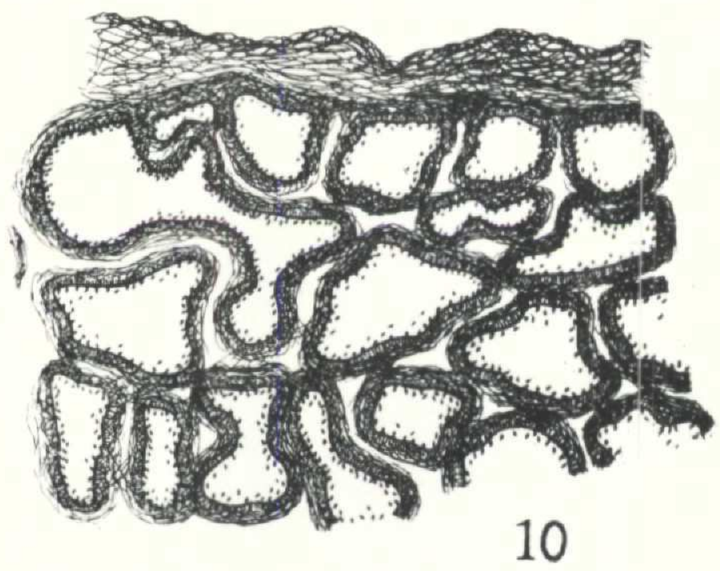

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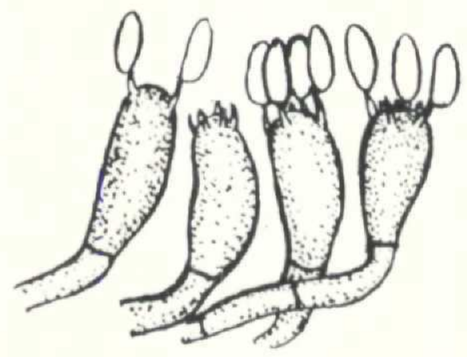


11

ZELLER AND DODGE—RHIZOPOGON

Explanation of Plate

PLATE 3

Fig. 1. Diagrammatic section of *Rhizopogon roseolus;* × 10.

Fig. 2. Showing the gelatinized basidia and long sterigmata of *R. roseolus;* × 800.

Fig. 3. Showing nuclear positions in the spores of *R. roseolus;* × 2400.

Fig. 4. Diagrammatic section of *R. induratus;* × 100.

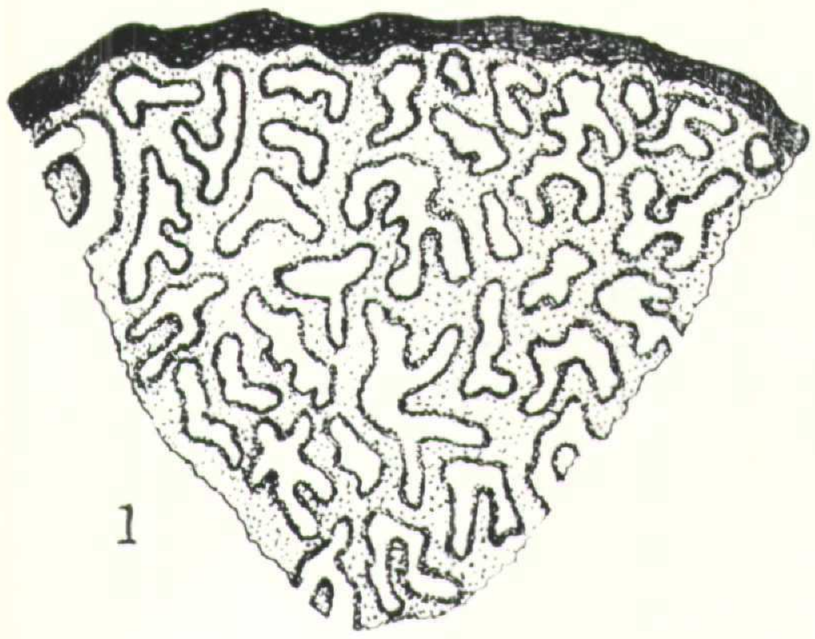
Fig. 5. Showing the basidia and spores of *R. induratus;* × 800.

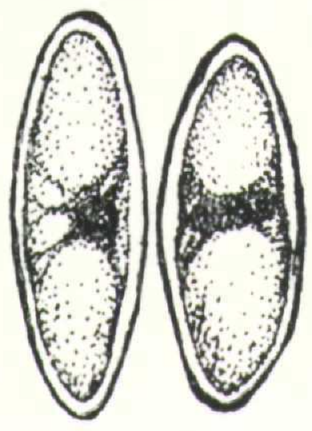
Fig. 6. Diagrammatic section of *R. angustisepta;* × 50.

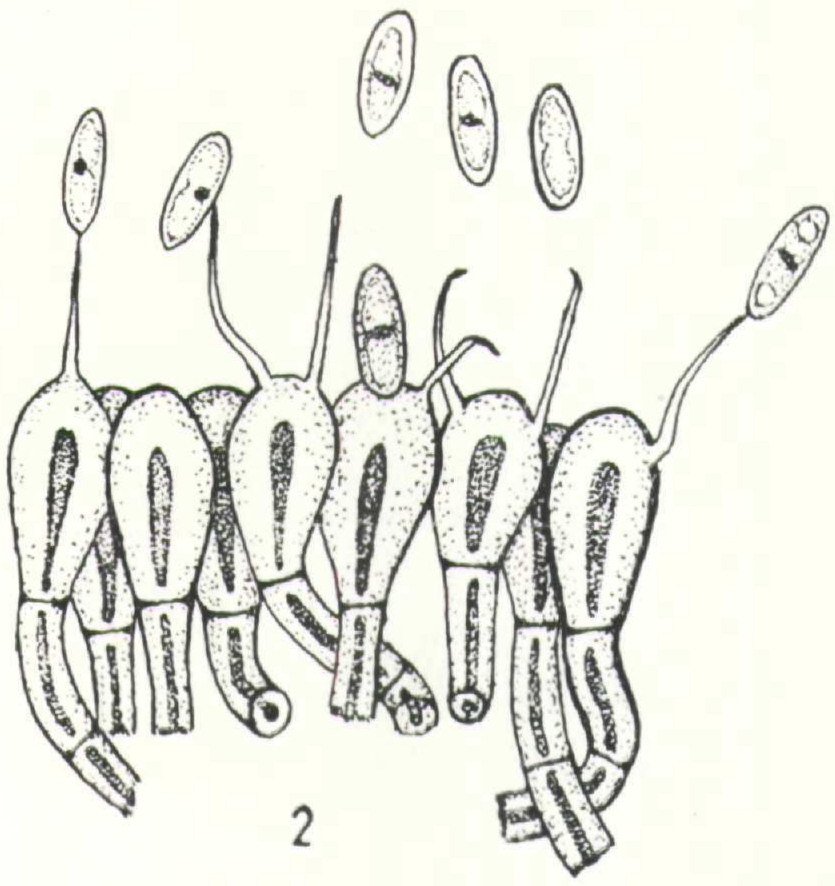
Fig. 7. Showing basidia of *R. angustisepta* embedded in a gelatinous matrix, and spores; ×830.

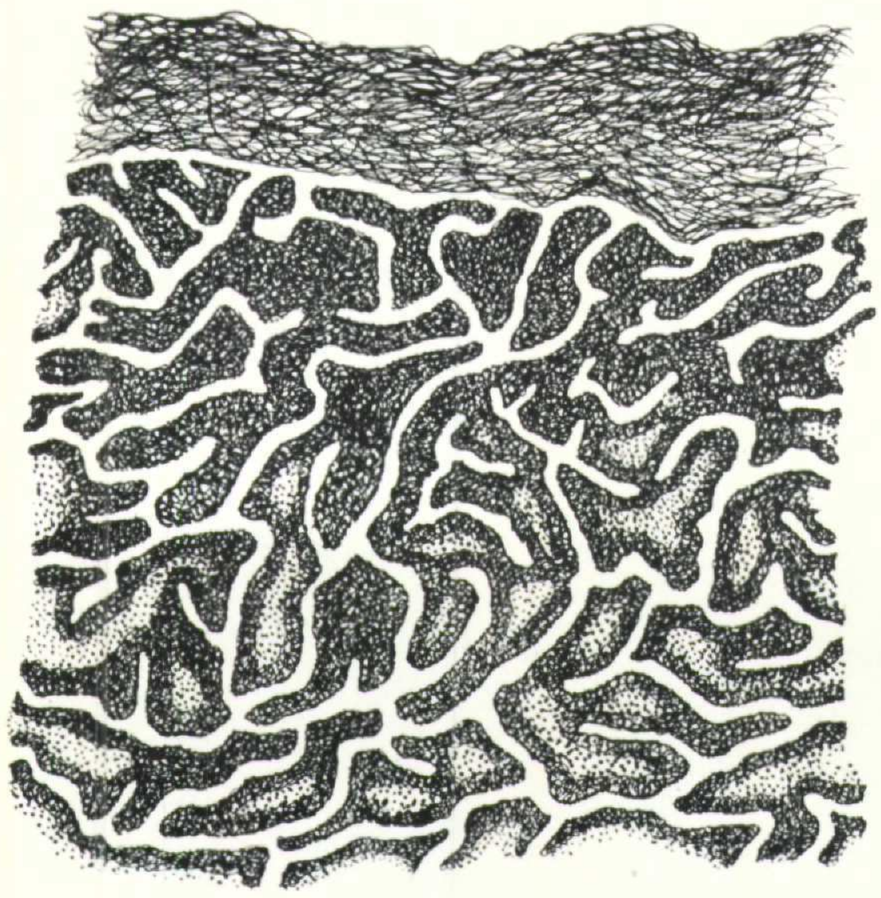
Fig. 8. Diagrammatic section of *R. rubrocorticeus;* × 10.

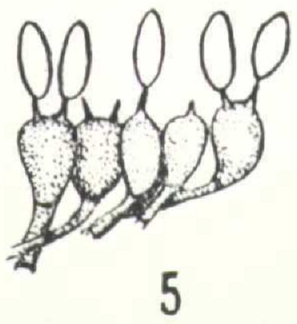
Fig. 9. Showing basidia and spores of *R. rubrocorticeus;* × 830.

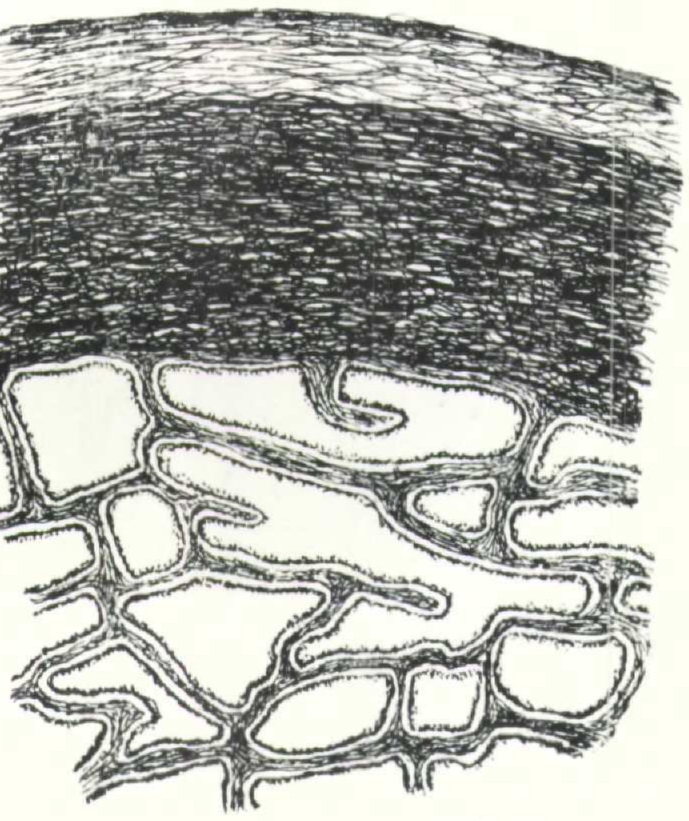


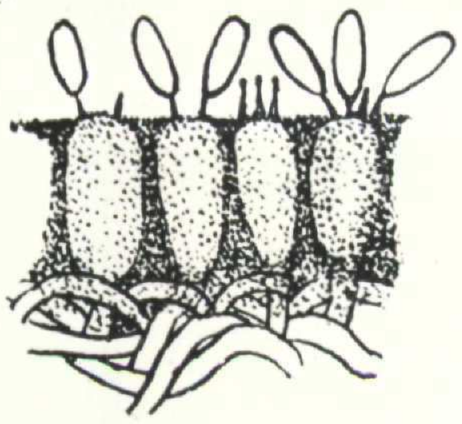


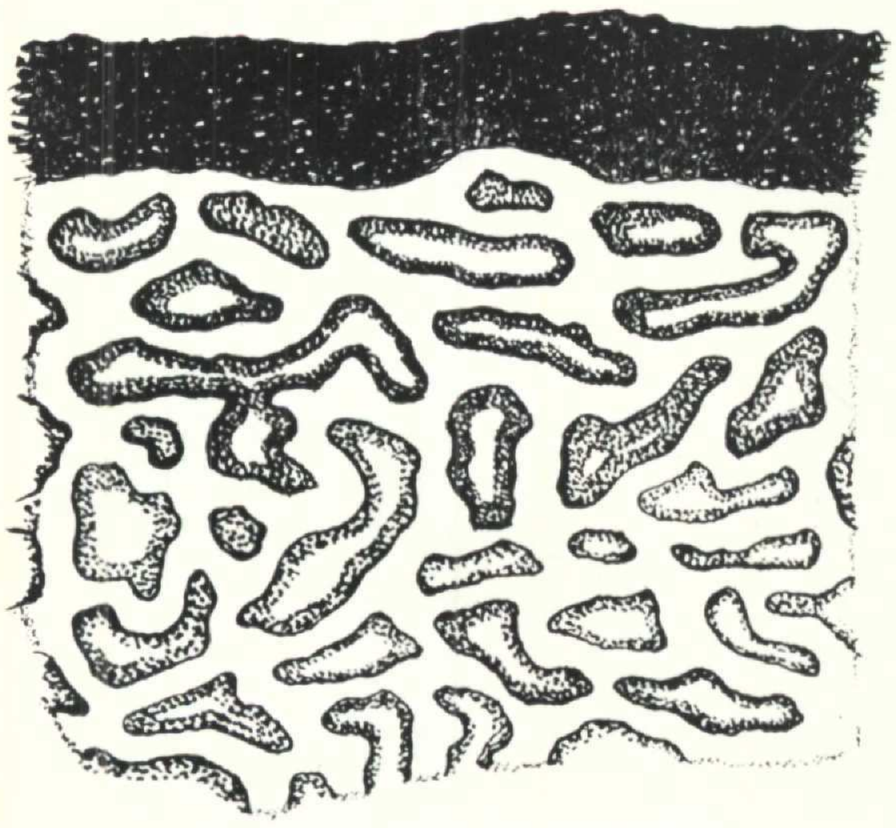


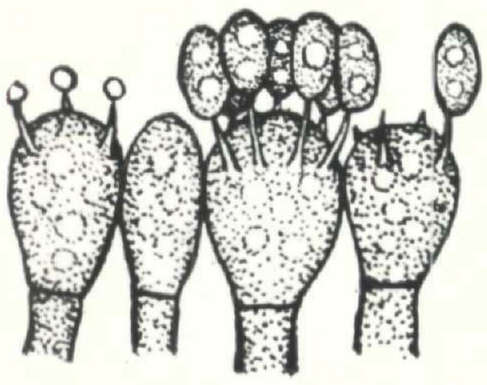












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